FriM01

Recent Development of Plasma-Optical Systems

Alexey A. Goncharov

Institute of Physics National Academy of Science in Ukraine, Kiev, 03028, Ukraine

Corresponding author: Alexey Goncharov, e-mail address: gonchar@iop.kiev.ua

This is the brief review of recent development and ongoing research of plasma optical systems based on the fundamental plasma optical idea magnetic electron isolation, equipotentialization magnetic field line and the axial-symmetric cylindrical electrostatic plasma lens (PL) configuration. The electrostatic PL is well-explored tool for focusing and manipulating large area, intense, positive light and heavy ion beams, where the concern of beam space charged compensation is critical. The crossed electric and magnetic fields inherent the PL configuration provides a suitable method for establishing a stable discharge at the low pressure. Using PL configuration in this way several low maintenance and high reliability plasma generation devices were developed. These kind of devices are part of a large class plasma devices (hall-type plasma accelerators, jet propulsions, magnetically insulated diodes) that use a discharge in crossed electric and magnetic fields with closed electron drift for the generation, formation and manipulation of intense ion beams and ion plasma flows. This background development opened up a new possibility to use PL configuration with a positive space charge cloud for focusing high current negative charged particles beams (electrons and negative ions).. Here briefly describes the results of wide-aperture (6 cm) non-relativistic (up to 20 keV) intense (from 100 mA up to 100 A) electron beam focusing by the positive space charge PL. The experiments have been carried out in the Tomsk (HCEI SB RAS) with using plasma lens produced by IP NASU. These experimental results demonstrate an agreeable possibilities application positive space charged plasma lens with magnetic electron insulation for focusing and manipulating wide aperture, high-current, no relativistic electron beams.. We describe also the original approach for effective additional elimination of micro droplets in a density flow of vacuum arc plasma. This approach is based on application the cylindrical PL configuration for introducing at volume of propagating along axis's dense low temperature plasma flow convergent radially energetic electron beam generated by ion –electron secondary emission from electrodes of plasma optical tool. The theoretical appraisals and experimental demonstrations that have been carried out at the IP NASU provide confidence and optimism that proposed idea for removal and clearing the micro droplet component from dense metal plasma has the high practical potential for elaboration novel state-of-the-art plasma processing for the filtering of micro droplets (or their reduction to the nanoscale) from the plasma formed by erosion plasma sources like vacuum arc and laser produced plasma. Note also, these energetic electrons could be attractive for additional stripping ions at the MEVVA ion source.

References

Alexey Goncharov Invited Review Article: The Electrostatic Plasma Lens, Rev. Sci. Instrum. 84, 021101 (2013)

A.A.Goncharov, A.N.Dobrovolsky, S.N. Dunets, I.V.Litovko, V.I. Gushenets and E.M. Oks, Rev.Sci. Instr. 83, 02B723 (2012)

A.A.Goncharov, V.I. Maslov, A.Fisk 55th SVC Annual Techn. Conference Proceedings, pp.441-444, Santa Clara, CA (2012),